

# Could MRI and CT Scanners Be Operated More Intensively in Canada?

Les appareils IRM et les tomodensitomètres  
pourraient-ils être utilisés de façon plus  
intensive au Canada?



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## Abstract

Although availability of necessary equipment could play a role in wait times for MRI and CT exams in Canada, there are other dimensions to this issue. More machines in operation do not necessarily reduce wait times. It is important also to consider the level of utilization of the existing pool of scanners.

This paper analyzes utilization of MRI and CT scanners (machines) by focusing on two indicators: the number of exams per machine per year and the number of hours of operation per machine per week. These values were calculated and reported

by province, followed by an assessment of the average level of utilization of MRI and CT scanners in Canada. The findings suggest that some provinces use their MRI or CT scanners less intensively than others. On average, in Canada, an additional 31% operating capacity may exist for MRI and 68% for CT without additional capital or infrastructure investments. However, supply-side as well as demand-side constraints may prevent a given jurisdiction from operating at full capacity.

## Résumé

Bien que la disponibilité de l'équipement nécessaire pourrait jouer un rôle dans les temps d'attente pour les examens IRM et les tomodensitogrammes au Canada, d'autres facteurs entrent en ligne de compte. Le fait d'avoir davantage d'appareils ne contribuera pas nécessairement à réduire les temps d'attente. Il est également important de tenir compte du niveau d'utilisation des appareils existants.

Cet article examine l'utilisation des appareils IRM et des tomodensitomètres en mettant l'accent sur deux indicateurs : le nombre d'examens effectués par appareil par année et le nombre d'heures de fonctionnement par appareil par semaine. Ces valeurs ont été calculées et présentées par province, suivies d'une évaluation du niveau moyen d'utilisation des appareils IRM et des tomodensitomètres au Canada. Ces constatations suggèrent que certaines provinces utilisent leurs appareils IRM ou leurs tomodensitomètres de façon moins intensive que d'autres. En moyenne, au Canada, les appareils IRM et les tomodensitomètres pourraient fonctionner respectivement à une capacité 31 % et 68 % plus élevée qu'actuellement, et ce, sans aucune nouvelle injection de capitaux ou d'investissements supplémentaires dans l'infrastructure. Toutefois, les contraintes de l'offre et de la demande pourraient empêcher certaines provinces d'utiliser ces appareils à leur pleine capacité.

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## Introduction

Although availability of necessary equipment could be a factor in wait times for MRI and CT exams in Canada, there are other dimensions to this issue. More machines do not necessarily mean a commensurate increase in imaging services or less time waiting. The machines could be underutilized for a variety of reasons, including insufficient operating funds, lack of staff to run the machines or interpret the results, and technical or clinical constraints.

It is important also to consider the level of utilization of the existing pool of scanners. A low level of utilization may suggest a potential to perform additional exams without buying more or newer machines. Conversely, a high level of utilization may

indicate that the existing scanners are operating at (or close to) full capacity, suggesting that more scanners are needed for an expansion of service volumes.

This paper addresses the utilization issue by focusing on two primary indicators: the number of exams per machine per year and the number of hours of operation per machine per week. In an effort to provide a more comprehensive picture, other indicators are reported as well. The values were calculated and reported by province, followed by an assessment of the average level of utilization of MRI and CT scanners in Canada.

While data have been published on indicators of utilization of MRI and CT scanners in some jurisdictions, they have not generally been compiled Canadawide. In the literature on wait times in Canada, such indicators were considered at the national level only by a few studies. Rankin (1999) reported on supply and number of hours of operation of MRI scanners at the national level. While the supply of MRI scanners in Canada was compared to other countries, no attempt was made to derive indicators of output and discuss differences among provinces in the intensity of operation of MRI machines. In her report for the MRI and CT Expert Panel, Keller (2005) discussed the level of utilization and efficiency of MRI and CT scanners and introduced recommendations based on some best-practice standards and guidelines. However, the report applied only to the province of Ontario and cannot be extrapolated with ease to the rest of Canada. In the national report *Medical Imaging in Canada 2005*, the Canadian Institute for Health Information (CIHI 2006) derived the above-mentioned indicators and found that MRI and CT scanners are used more intensively in Canada than in the United States or England.

This paper builds on the report *Medical Imaging in Canada 2005*. The potential for additional exams is discussed for each province and for Canada, based on the national average number of exams per scanner per hour and the highest provincial average hours of operation per week that have been reported.

## Methods

The number of exams<sup>1</sup> was collected for MRI and CT scanners in Canadian hospitals and those in free-standing imaging facilities (sometimes called “non-hospital,” “community-based” or “private” facilities). The CIHI’s National Survey of Selected Medical Imaging Equipment asked respondents to report the number of MRI or CT exams performed during the fiscal year 2004/2005 as well as the average number of hours of operation per week. The number of exams was obtained for 91% of MRI scanners and 98% of CT scanners available in Canada.<sup>2</sup> As for the average number of hours of operation, it was collected for virtually all MRI and CT scanners available in Canada (99%).

The average number of exams per scanner for a given province is computed by dividing the total number of exams in the jurisdiction by the total number of scanners installed and in operation for which any exam was reported.<sup>3</sup>

The average number of hours of operation per week for a given province is computed by summing the average number of hours of operation per week reported for each machine in the province and dividing by the total number of machines for which any hour of operation was reported.

For each province, the possible percentage of additional exams is calculated by dividing the potential additional number of exams per scanner<sup>4</sup> by the actual average number of exams per scanner.

## Results and Discussion

Canada performs more exams per scanner than the United States or England, a finding that suggests a higher intensity of operation (CIHI 2006). But how intensively does each province operate its MRI and CT scanners compared to the Canadian average? The first two rows of Table 1 show, for each province, the number of exams per scanner reported for 2004/2005.

The number of reported MRI exams per scanner varies among the provinces and from the Canadian average and ranges from 2,218 exams (Prince Edward Island – 57% fewer MRI exams per scanner than the Canadian average) to 6,557 exams (Ontario – 27% more MRI exams per scanner than the Canadian average).<sup>5</sup> These variations could be explained by such factors as higher population density, differences in health needs of the population or variations in funding and reimbursement systems. It should be emphasized that this analysis is at the provincial level and not at the facility level. Thus, a province can be at a level below the national average, but a given facility within this province could be well above the national average. Also, a province can be below the national average for the number of exams per scanner but above the national average for the number of exams per thousand population; hence the importance of reporting the number of exams per thousand population in the third and fourth rows of Table 1.<sup>6</sup> For example, in 2004/2005, Prince Edward Island performed about 40% fewer CT exams per scanner than the Canadian average (4,747 versus 8,034) but performed 18% more CT exams per thousand population than the national average (103.4 versus 87.3). This may reflect the fact that the number of CT scanners per million population in Prince Edward Island is almost twice the national average.

According to CIHI's 2005 National Survey of Selected Medical Imaging Equipment, on average, Canadian facilities operated their MRI scanners 66 hours per week, within a range of 90 hours in Newfoundland and Labrador to 40 hours in Prince Edward Island (see row 5 of Table 1). Two other provinces (Manitoba and Ontario) had average hours of operation per week, almost as high as Newfoundland and Labrador. There was less variability in the number of hours of operation per week for CT scanners among provinces. The provincial averages ranged from 65 hours in Ontario to 43 hours in Prince Edward Island, with a national average of 57 hours (row 6 of Table 1).

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**TABLE 1. Number of MRI and CT exams per scanner and per thousand population,<sup>i</sup> number of hours of operation per week for MRI and CT scanners,<sup>i</sup> number of MRI technologists per million population<sup>ii</sup> and number of MRI and CT scanners per million population,<sup>iii</sup> by province, Canada**

	<b>NL</b>	<b>PEI</b>	<b>NS</b>	<b>NB</b>	<b>Que</b>
MRI Exams per Scanner	4,375	2,218	n/a	4,606	4,325
CT Exams per Scanner	5,175	4,747	7,480	9,208	6,678
MRI Exams per thousand pop	8.5	16.1	n/a	30.6	21.7
CT Exams per thousand pop	100.1	103.4	119.6	134.8	90.1
Hrs of Operation per Week (MRI)	90	40	71	49	55
Hrs of Operation per Week (CT)	47	43	50	45	55
MRI Technologists per million pop	9.7	29.0	16.0	41.3	2.0 <sup>iv</sup>
MRI Scanners per million pop	1.9	7.3	5.3	6.7	6.5
CT Scanners per million pop	19.3	21.8	16.0	14.6	14.0

	<b>Ont</b>	<b>Man</b>	<b>Sask</b>	<b>Alta</b>	<b>BC</b>	<b>Can</b>
MRI Exams per Scanner	6,557	4,060	5,371	4,898	3,361	5,168
CT Exams per Scanner	9,880	7,891	7,423	9,722	7,160	8,034
MRI Exams per thousand pop	27.4	20.8	16.2	36.6	18.4	25.5
CT Exams per thousand pop	79.4	114.3	89.4	90.8	78.2	87.3
Hrs of Operation per Week (MRI)	82	88	61	62	54	66
Hrs of Operation per Week (CT)	65	55	49	57	52	57
MRI Technologists per million pop	21.3	16.2	12.1	40.0	23.6	18.6
MRI Scanners per million pop	4.7	5.1	3.0	7.8	5.5	5.5
CT Scanners per million pop	8.7	14.5	13.1	9.3	10.9	11.3

Sources: National Survey of Selected Medical Imaging Equipment and Health Personnel Database, Canadian Institute for Health

### Notes

i: 2004-2005

ii: 2004

iii: As of January 2005

iv: Not a regulated specialty in Quebec. The data represent the numbers certified in Medical Resonance Imaging by the Canadian Association of Medical Radiation Technologists (MRTs).

n/a = not available

Lack of specialized professionals – such as qualified technologists, radiologists and physicians – to interpret the results could be perceived as a factor that prevents a province from operating longer hours per week. Row 7 of Table 1 reports on the number of active and regulated members of Medical Radiation Technologists' associations in the discipline of MRI technology in 2004, by province and nationally. There is not a strong relationship between the number of reported MRI technologists per

million population and the average weekly hours of operation of MRI scanners. Unfortunately, data for CT technologists are not available.

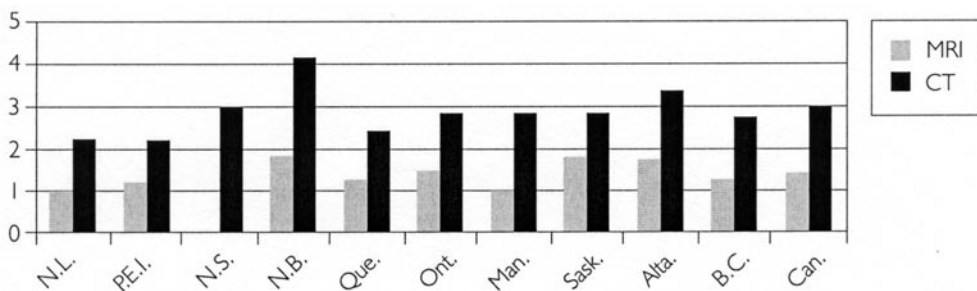
A higher number of scanners per million population could allow lower average hours of operation per week. The last two rows of Table 1 show the number of MRI and CT scanners per million population as of January 1, 2005, by province and for Canada. A negative relationship between the average hours of operation per week and the number of scanners per million population has been found, and this relationship is stronger for CT than for MRI (CIHI 2006).

According to CIHI's 2005 National Survey of Selected Medical Imaging Equipment, nationally, there were on average 1.5 MRI exams per hour per scanner and 3.0 CT exams per hour per scanner in 2004/2005 (see Figure 1).

If each province were able to achieve the national average of exams per hour and could operate the scanners 90 hours per week (15 hours per day, six days per week<sup>7</sup>), then how many more exams could be performed in each province? Figure 2 presents the percentage of additional exams that could be performed.

Under these specific conditions, an additional 31% operating capacity may exist for MRI and 68% for CT exams per year in Canada without additional capital or infrastructure investments. There are provincial variations in available space to perform additional exams, both for MRI and CT; Ontario seems to have the least available space (3% and 37%, respectively).

FIGURE 1. Average number of exams per hour per scanner, 2004/2005

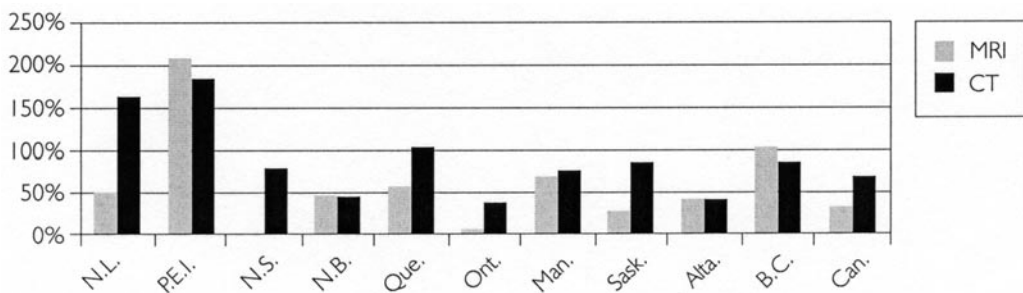


Source: National Survey of Selected Medical Imaging Equipment 2005, Canadian Institute for Health Information

However, provinces may be unable to achieve these levels for various reasons, including supply-side and demand-side constraints. Supply-side constraints include insufficient operating funds; restrictions in the number of hours available for work by medical radiation technologists, particularly among female MRTs (Wenzl and Lauzon 2005), given that 80% of MRTs are women (Statistics Canada 2001); and an increasing preference among MRTs to work day shifts. A further supply-side constraint is the

limited number of radiologists to interpret the results. In 2005, 38.6% of diagnostic radiologists in Canada were 55 years or older (CMA 2006). Older radiologists, with little or no training in MRI or CT, have tended to restrict their practices to other imaging modalities (Keller 2005).

FIGURE 2. Estimated possible percentage of additional exams in each province (based on national average number of exams per hour in 2004/2005, 90 hours per week and 50 weeks per year)



On the demand side, the potential increase in exams might not be achieved if the demand for services in a particular area or region is below the available capacity, or if the demand cannot be sustained over longer work weeks. Moreover, increasing the number of exams does not always improve health status, because not every test is necessarily beneficial or appropriate as an enabler of improved health status. Other reasons may be found in Laupacis and Evans (2005).

## Conclusion

The intensity of utilization of MRI or CT scanners varies among the provinces. On average, in Canada, an additional 31% operating capacity may exist for MRI and 68% for CT without additional capital or infrastructure investments. However, supply-side as well as demand-side constraints may prevent a given jurisdiction from operating at full capacity.

For more information, visit [www.cihi.ca](http://www.cihi.ca) to download the report *Medical Imaging in Canada 2005*.

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## NOTES

1. Examinations are defined as a technical investigation using an imaging modality to study one body structure, system or anatomical area that yields one or more views for a diagnostic and/or therapeutic purpose (that is, one exam can include more than one scan). Exceptions include routinely ordered investigations of multiple body structures that, by common practice or protocol, are counted as one exam.
2. Quebec and Ontario were the two provinces for which the number of MRI and CT exams was not collected for all scanners. For CT, underreporting did not differ significantly between the two provinces and was lower than 5%. However, for MRI, the underreporting was more important in Quebec than in Ontario (17% versus 9%).
3. A mobile scanner is always counted as one scanner, even though exams performed on this scanner may be reported by more than one site.
4. The potential additional number of exams per scanner is based on 90 hours of operation per week (15 hours per day, 6 days per week) and 1.5 exams per hour for MRI or 3.0 exams per hour for CT. For each province, 90 hours of operation per week are considered potentially feasible, as one province actually operated its MRI scanners at this level in 2004/2005, and two provinces were near this level. In 2004/2005, in Canada, there were on average 1.5 exams per hour of operation of MRI scanners and 3.0 exams per hour of operation of CT scanners. These national levels are considered potentially attainable in each province.
5. The number of MRI exams per machine in Nova Scotia is not discussed because investigations reveal some reporting problems in the count of MRI exams in this province.
6. Because of the different demographic structures of the provinces, standardization for age and gender would be useful. However, age-specific utilization data are not available from the survey.
7. Three provinces (Newfoundland and Labrador, Ontario and Manitoba) ran their MRI scanners at (or close to) 90 hours per week.

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